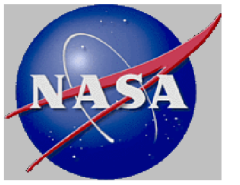
National Aeronautics and Space Administration



International and NASA SSA and Safety of Flight Issues

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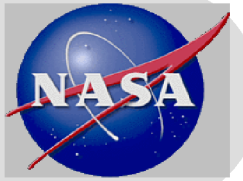
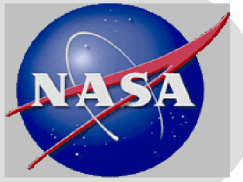
JFCC Space / J3
Space Operations Conference
26-28 January 2010

Outline



- **United Nations Committee on the Peaceful Uses of Outer Space**
  - Space debris mitigation guidelines
  - International satellite database
  - Long-term sustainability of outer space activities
- **Inter-Agency Space Debris Coordination Committee**
- **U.S. - Russian and US - Chinese space surveillance workshops**
- **NASA Safety of Flight Issues**

United Nations COPUOS



- **The United Nations Committee on the Peaceful Uses of Outer Space (COPUOS) meets annually in June at the UN complex in Vienna, Austria, to discuss a wide variety of topics, including space debris, nuclear power sources in space, and space applications.**

- **COPUOS employs the use of two subcommittees to conduct the majority of its business and deliberations.**

  - Scientific and Technical Subcommittee (STSC) meets every February.
  - Legal Subcommittee (LSC) meets in March or April.

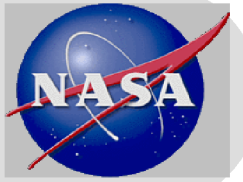
- **Space debris has been an agenda item for the STSC since 1994**

  - Technical Report on Space Debris issued in 1999
  - Space Debris Mitigation Guidelines adopted in 2007 (adopted by UN General Assembly in late 2007)

Recent UN Highlights

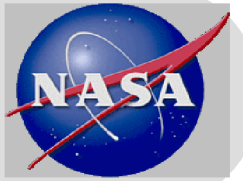
- **Each year the U.S. makes a presentation to the STSC on the state of the near-Earth space environment, U.S. accomplishments in space debris mitigation, and recent significant space events.**
  - 2007: Chinese ASAT test
  - 2008: USA-193 engagement
- **The collision of Iridium 33 and Cosmos 2251 occurred only one week before STSC addressed space debris in 2009.**
  - A preliminary assessment of the collision was presented by the U.S. at STSC in February.
  - Two more comprehensive presentations were made by the U.S. at the full COPUOS meeting in June.

Recent UN Highlights (continued)



- **At the 2009 STSC meeting Germany and Italy made a joint proposal to establish an internationally accessible database of satellite information "to avoid collisions in outer space between operational spacecraft and space debris and other operational spacecraft respectively, as well as to protect the Earth's population in case of re-entering debris".**
  - Conceivably, the database would be maintained by the UN Office of Outer Space Affairs.
  - Calls in previous years by Russia for a complete database of satellite orbital elements had failed to gain support.
- **STSC requested the Inter-Agency Space Debris Coordination Committee (IADC) "to develop first ideas on concrete measures with the purpose of making available already existing sources of information as well as data and information on objects in outer space for the promotion of a safe and sustainable development of the peaceful uses of outer space".**
  - A response from IADC has been prepared and will be delivered at the STSC meeting next month.

Long-Term Sustainability of Space Operations

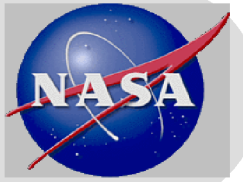


- **In February 2008 informal discussions, at the initiative of France, were held to discuss the long-term sustainability of space operations.**
  - 15 countries and 5 commercial satellite operators / international governmental organizations attended.

Four major objectives were accepted for work during 2008:

- "To identify and exchange views on the concerns associated with long term sustainability of activities in space;
- "To exchange views on what information and data are needed to better monitor the space environment in order to operate safely in space;
- "To exchange views on possible mechanisms to ensure the safety of space activities in the long term; and
- "To prepare an outline document to be submitted to the UN COPUOS with a view to consideration of this topic and setting up a dedicated Working Group under a multi-year work plan."

Long-Term Sustainability of Space Operations (continued)



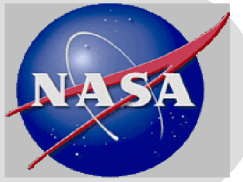
- **Following multiple informal meetings of interested parties in 2008 and 2009, the UN COPUOS approved in June 2009 a new agenda item for the STSC in 2010 on the "Long-term Sustainability of Outer Space Activities".**
  - Multi-year work plan
  - Anticipated establishment of a new STSC Working Group

- **Work plan will include "a general exchange of views on present and future challenges facing outer space activities, as well as potential measures that could enhance the long-term sustainability of outer space activities".**

Potential topics for examination:

- Space debris
- Space weather
- Space operations
  - SSA
  - Collision avoidance processes and procedures
  - International data center or clearing house for operational information
  - and other subjects

Inter-Agency Space Debris Coordination Committee



- The IADC was formally established in 1993, and its membership now includes the space agencies of 10 countries plus ESA.

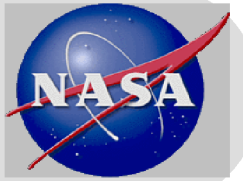
- The purpose of the organization is to exchange data and research results over the entire spectrum of orbital debris issues, including measurements, modeling, protection, and mitigation.

- The IADC is an independent intergovernmental organization which provides technical assistance to UN COPUOS.

- In the area of SSA, the IADC conducts periodic orbital debris observation campaigns, primarily focused either on LEO or GEO.

- Recent GEO observations have sought to define the small debris population between 10 cm and 1 m with emphasis on numbers of debris, area-to-mass ratios, and spectral characteristics.

IADC Reentry Exercise in 2009



- **In 1998 the IADC created a risk object reentry data exchange network to provide real-time orbital data and reentry predictions in the event of the uncontrolled reentry of a hazardous man-made object.**
  - No need has yet arisen for operational activation.
  - Would have been employed if the engagement of USA-193 had failed.

- **To date the IADC has conducted 11 risk object reentry exercises employing decaying targets of opportunity.**
  - Normally large, moderate-to-high inclination objects in nearly circular orbits.
  - U.S. inputs include TLEs and information from TIP messages.

- **For the first time the exercise in June-July 2009 involved a spacecraft in a highly elliptical orbit (Molniya 3-39).**
  - Orbital data provided by U.S. and Russia
  - Reentry predictions provided by China, ESA, France, Germany, India, Italy, Japan, Russia, U.K., and U.S.

U.S. - Russian and U.S. - Chinese Space Surveillance Workshops

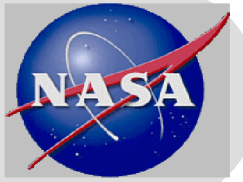
- **Since 1994 seven U.S. - Russian Space Surveillance Workshops have been held to promote a better understanding of orbit determination in general and in the operations of the U.S. Space Surveillance Network and the Russian Space Surveillance System.**

- **The 7th meeting was held in Monterey, CA, in 2007 with a focus on the development of a more complete satellite catalog. The 8th meeting was planned to be held on Maui in October 2009. However, visa issues required a rescheduling of the meeting to 19-23 April 2010 at the same location. The theme will be deep space tracking challenges.**

- **The first U.S. - Chinese Space Surveillance Workshop was held 1-5 June 2009 at the Shanghai Astronomical Observatory.**

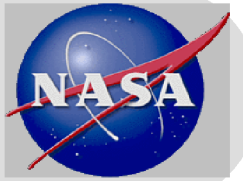
  - Eight U.S. representatives from NASA, industry, and academia
  - 10 Chinese and 11 U.S. papers presented
  - Visits to SAO Zo-san GEO observatory and VLBI, as well as the new Purple Mountain Observatory Jiangsu site with facilities for LEO, MEO, and GEO space surveillance.

NASA Collision Avoidance Activity in 2009



- **NASA continues to rely on JSpOC conjunction assessments to promote the safety of both human space flight and robotic missions.**
  - The NASA Johnson Space Center is the lead for human space flight
  - The NASA Goddard Space Flight Center is the lead for robotic missions.
- **NASA Procedural Requirements (NPR) 8715.6A require conjunction assessments for all NASA maneuverable spacecraft in LEO and GEO.**
- **During 2009 NASA executed eight collision avoidance maneuvers, but many more close approaches were analyzed and countermeasures considered.**
  - International Space Station: 2 (plus one retreat to Soyuz)
  - Space Shuttle: 1
  - Earth Observation Network: 4 (plus maneuver by French satellite in network)
  - TDRS: 1

Long-term On-orbit and Reentry Risks

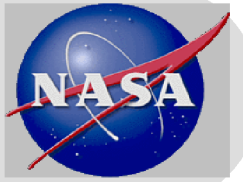


- **NASA studies (now confirmed internationally) indicate that the current resident space object population is sufficient to lead to a net growth in the total satellite population via accidental collisions, e.g., Iridium-Cosmos collision.**

- **During 8-10 December 2009, NASA and DARPA co-hosted the first international conference on orbital debris removal. More than 50 papers were presented.**
  - Solutions remain challenging due to technical, economic, and policy issues.

- **The U.S. and several other countries limit human casualty risks to no more than 1 in 10,000 per reentry event. Options are**
  - Controlled de-orbit
  - Disposal orbit above LEO or in deep space
  - Limit surviving components via Design for Demise
    - NASA is increasing its effort for D4D; each spacecraft is evaluated
    - Demisable hydrazine propellant tanks now available

Summary



- **International interest in more comprehensive exchanges of SSA data have increased markedly in 2009, in part due to the Iridium-Cosmos collision.**
  - Although raised at UN COPUOS STSC in 2009, this is not an official agenda item.
- **The topic of the long-term sustainability of outer space activities has matured during the past two years, and an official multi-year work effort will commence in February at UN COPUOS STSC.**
  - The anticipated outcome of this work is not yet well defined.
- **Additional bilateral and multi-lateral SSA endeavors are very likely.**